SOIL-SERUM PCB ASSOCIATIONS IN THE ANNISTON COMMUNITY HEALTH SURVEY

Pavuk M[1], Ha H[2], Olson JR[3], Dearwent SM[1], Sjödin A[4], Bian L[2], Rogerson P[2] for the Anniston Environmental Health Research Consortium

[1]Agency for Toxic Substances and Disease Registry, CDC, Atlanta, GA; [2]Department of Geography, University at Buffalo, Buffalo, New York, USA; [3]Department of Pharmacology and Toxicology, University at Buffalo, Buffalo, New York, USA; [4]National Center for Environmental Health, CDC, Atlanta, GA

Introduction:

Anniston, Alabama, was the location of one of two facilities in the United States where polychlorinated biphenyls (PCBs) were produced from 1929 until 1971. It was not until the mid 1990s that the extent of environmental contamination and human exposure to PCBs began to be investigated. In 2003, the US EPA started the large scale remediation of PCB contaminated residential soil in Anniston. Over twenty thousand soil samples from different depths were collected and analyzed and about 500 residential properties had the surface soil removed and replaced (http://www.epa.gov/region04/waste/npl/nplal/annpcbal.htm). Anniston Community Health Survey (ACHS) efforts were separate from the US EPA activities, but aware of the major undertaking by EPA, the agreement was made that the results of soil PCB analyses would be available to ACHS investigators to examine this potential pathway of exposure to PCBs in Anniston residents.

Methods:

The US EPA database contained total PCB levels (parts per million [ppm] or mg/kg) for 7,109 residential soil samples from 2,639 properties in Anniston taken from the upper 3 inches (0.25 feet) of soil. Measurements taken at other soil depths were not analyzed at this time. Information on the associated address and geographic coordinates is also contained in the database. Total PCBs in soil were analyzed by EPA method 8082. Serum from the ACHS participants was analyzed for a total of thirty five ortho-substituted PCBs by the Center for Disease Control and Prevention's National Center for Environmental Health laboratory using high-resolution gas chromatography/isotope-dilution high-resolution mass spectrometry (HRGC/ID-HRMS). The current addresses of ACHS participants were also assigned geographical coordinates and were matched to the coordinates within the EPA files. The selection of participants for ACHS and selection of locations/residences for soil sampling were not coordinated; spatial distribution methods were used to assign soil sample measurements to a particular address/geographic coordinates in the ACHS file. Twenty five meter (25m) and 50 meter (50m) radius buffer analyses were used to locate the residential addresses in ACHS in the proximity of soil measurements in the EPA database. Average and maximum soil levels were calculated for buffer analyses methods. Up to 4 soil samples per residence were used to calculate average soil PCB level in 25m buffer radius (median=1) and up to 14 soil samples for the 50 m radius buffer (median=3). In addition, we used Kriging procedure for spatial prediction at an unobserved location, using data at observed locations, to increase the number of residences we could use in the statistical analyses. Correlation analyses and linear regression models were used to examine associations between soil PCB levels and other covariates for the three sets of soil levels.

Results and Discussion:

The geographic coordinates of the current address of 106 ACHS participants were within 25m radius buffer of the soil samples collected and measured by the EPA. Fifty meters radius buffer included 233 such addresses/properties of the ACHS participants. The mean of average soil levels at 0.25 feet depth for 25m radius buffer was 0.50 ppm (Standard Deviation [SD] 1.08). For the average soil levels at 50m radius buffer the mean was 0.55 ppm (SD 1.18). Maximum soil levels at any residence identified by the two methods were 15.6 ppm and 34.8 ppm, respectively. A proportion of properties with at least one soil PCB measurement above 1 ppm was about 16% for the 25m radius buffer and almost 30% for the 50m radius buffer method. Kriging procedure used EPA soil data to interpolate locations for which no measurements were taken to generate the geographic maps of Anniston and provided soil PCB estimates for 625 ACHS participants (mean 0.19 ppm, SD 0.30). Correlations of soil measurements obtained by radius buffer methods and Kriging procedure were relatively high ($r>0.60$, $p=0.001$). Preliminary correlation analyses between soil and serum levels in Anniston residents that participated in ACHS suggest low correlation coefficients for all three sets of soil levels ($r<0.15$). Linear regression analyses using additional covariates collected in ACHS and with PCB measurements at different soil depths are ongoing.

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